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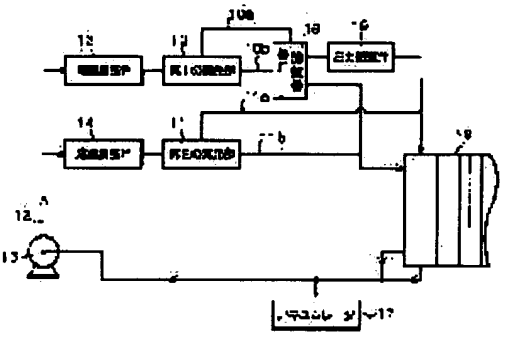
(54) TWO-PHASE FLUID LOOP TYPE HEAT CONTROL SYSTEM

(57)Abstract:
PROBLEM TO BE SOLVED: To diversify a heat controlling range and to simplify handling including designing with a simple constitution by controlling a desired vapor pressure of an evaporator, and controlling a hydraulic pressure of a liquid passage of the evaporator.
SOLUTION: Vapor-liquid separation type first and second evaporators 10, 11 are disposed in a liquid passage 12 of a twophase fluid loop. Only supply amount of operating liquid is variably controlled in the state that a differential pressure between its vapor passage 10a and a liquid passage 10b is held at a desired value in the first evaporator 10, and its temperature control range is set to a control range different from a temperature control range of the evaporator 11. Thus, vapor-liquid separating function of the evaporator 10 is ensured, and then set to different from a temperature control range of the evaporator 11. Accordingly, thermal control of a heater different from a heating amount is simultaneously executed in the same two-phase fluid loop, and hence components can be alleviated and simplification of design is realized.



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CLAIMS

[Claim(s)]
[Claim 1] The two-phases flow object loop formation which is formed on the liquid route to which a working fluid is transported, and the steamy way to which a gas is transported, and performs endoergic and heat transport using the phase change of said working fluid, A loop-formation setting pressure means to set up the pressure of this two-phases flow object loop formation, and to set up working-fluid evaporation temperature, Two or more evaporators arranged by the juxtaposition which has the liquid path and steamy path which are opened for free passage by the liquid route and steamy way of said two-phases flow object loop formation, is thermally combined to a heating element, and absorbs the heating value of this heating element through said working fluid, After at least one of the evaporators of these plurality has maintained the differential pressure of a steamy path and a liquid path at a desired value The control range setting means which carries out an adjustable setup of the amount of supply of a working fluid, and carries out adjustable control of the temperature control range of this evaporator, The two-phases flow object loop-formation type thermal control system possessing the radiator which condenses the steam from the steamy path of said evaporator, and exhausts a heating value, and the circulation means which carries out circulation supply of the working fluid condensed with this radiator in the liquid route of said two-phases flow object loop formation.
[Claim 2] Said control range setting means is a two-phases flow object loop-formation type thermal control system according to claim 1 characterized by consisting of a pressure regulating valve which adjusts the pressure of the evaporation path of an evaporator, and a differential pressure regulator which adjusts the pressure of the liquid path of an evaporator following this pressure regulating valve, and sets differential pressure as a desired value.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the two-phases flow object loop-formation type thermal control system which carries out suitable to using for the thermal control of a spacecraft including a satellite.
[0002]
[Description of the Prior Art] In recent years, in the field of space development, it is going to realize many class-ization of a loading device with large-sized-ization of a loading device using a large-sized spacecraft. If it is in such a spacecraft, in the gross calorific value from the heating element containing the loading device attaining to dozens kw(s), it is that the highly precise temperature control which the temperature control range covers intricately and variably is needed, and with an ordinary heat pipe and the exhaust heat equipment using a thermal louver, since correspondence is difficult, a lot of heating values are efficiently requested from the thermal control system in which temperature control is possible.
[0003] As the above-mentioned thermal control system, the perimeter of a heating element is made to circulate through a working fluid, and it is thought that the two-phases flow object loop-formation type using the fluid loop formation of the two phase type which conveys and carries out the thermal control of the heating value using the phase change of this working fluid is effective. This two-phases flow object loop-formation type thermal control system connects the radiator for heat dissipation called the evaporator called the cold plate in which effective heat transport is possible and a heating element is carried using a small quantity of a working fluid, and the radiator arranged in space on that configuration by the two-phases flow object loop formation formed on a liquid route and a steamy way. And while the accumulator and circulating pump for a temperature setup are arranged in the latter part of the radiator of a two-phases flow object loop formation in order and such a thermal control system carries out circulation migration of the working fluid into a loop formation with the circulating pump, the thermal control temperature value of a heating element is determined by setting up a loop-formation pressure with the pressure regulator called the accumulator.
[0004] And in such a two-phases flow object loop-formation type thermal control system, two or more above-mentioned evaporators are arranged in juxtaposition, in a two-phases flow object loop formation, to this evaporator, it is combined thermally, respectively and heating elements, such as an exoergic device, are usually arranged, and it is constituted so that the thermal control of each heating element may be carried out by this evaporator.
[0005] When a working fluid is supplied from the actuation liquid route of a two-phases flow object loop formation and the above-mentioned evaporator evaporates the working fluid, the heating value of a heating element is taken, the thermal control of this heating element is carried out, and the actuation volume is set up according to the calorific value of a heating element. As a setting means

of this actuation volume, in an evaporator, the separation material called the wit using capillarity is built, and the approach of making separate the surplus liquid and the steam of a working fluid which were supplied by this separation material, and discharging to a radiator is taken.
[0006] by the way, if it is in the above-mentioned two-phases flow object loop-formation type thermal control system, the temperature control range is determined according to the setting pressure of a two-phases flow object loop formation -- having -- as the thermal control object -- the temperature control range -- abbreviation -- the thermal control of the heating element which is same extent is presented. For this reason, in the above-mentioned two-phases flow object loop-formation type thermal control system, if it does not establish the two-phases flow object loop formation of dedication for every heating element in performing the thermal control of the heating element with which temperature control range differs, it has the problem that highly precise thermal control becomes large-sized by the difficult thing.
[0007] Moreover, according to this, in the above-mentioned two-phases flow object loop-formation type thermal control system, in order to receive constraint in the heating element in which thermal control is possible using the same two-phases flow object loop formation, it has the problem that the system design is very troublesome.
[0008]
[Problem(s) to be Solved by the Invention] As stated above, since it has constraint in the heating element in which thermal control is possible, in the conventional two-phases flow object loop-formation type thermal control system, it has the problem that the system design is very troublesome.
[0009] This invention aims at offering the two-phases flow object loop-formation type thermal control system which enabled it to attain facilitation of the handling including a design as was made in view of the above-mentioned situation, was a simple configuration and was able to attain diversification of the thermal control range.
[0010]
[Means for Solving the Problem] The two-phases flow object loop formation which this invention is formed on the liquid route to which a working fluid is transported, and the steamy way to which a gas is transported, and performs endoergic and heat transport using the phase change of said working fluid, A loop-formation setting pressure means to set up the pressure of this two-phases flow object loop formation, and to set up working-fluid evaporation temperature, Two or more evaporators arranged by the juxtaposition which has the liquid path and steamy path which are opened for free passage by the liquid route and steamy way of said two-phases flow object loop formation, is thermally combined to a heating element, and absorbs the heating value of this heating element through said working fluid, After at least one of the evaporators of these plurality has maintained the differential pressure of a steamy path and a liquid path at a desired value The control range setting means which carries out an adjustable setup of the amount of supply of a working fluid, and carries out adjustable control of the temperature control range of this evaporator, It has the radiator which condenses the steam from the steamy path of said evaporator, and exhausts a heating value, and the circulation means which carries out circulation supply of the working fluid condensed with this radiator in the liquid route of said two-phases flow object loop formation, and a two-phases flow object loop-formation type thermal control system is constituted.
[0011] According to the above-mentioned configuration, by a control range setting means' controlling the vapor pressure of a desired evaporator, and controlling the fluid pressure of the liquid path of this evaporator, it is in the condition that the differential pressure of the steamy path and liquid path was maintained at the desired value, and adjustable [of the amount of supply of the working fluid] is carried out, and the temperature control range is set as a desired value. Therefore, adjustable [of the temperature control range of an evaporator where differential pressure was set up] is carried out to the temperature control range of other evaporators, and it becomes possible [performing to coincidence the thermal control of the heating element with which calorific value

differs].
[0012]
[Embodiment of the Invention] Hereafter, the gestalt of implementation of this invention is explained to a detail with reference to a drawing. Fig. 1 shows the two-phases flow object loop-formation type thermal control system concerning the gestalt of 1 implementation of this invention, a cold plate is called, vapor-liquid-separation material, such as a wick, is built in, and the 1st and 2nd evaporators 10 and 11 are arranged in the liquid route 12 of a two-phases flow object loop formation by juxtaposition. And flow control valves 13 and 14 are connected to the input edge of these 1st and 2nd evaporators 10 and 11, and the liquid exhaust port of a circulating pump 15 is connected to these flow control valves 13 and 14 through **** 12. A radiator 16, for example, a radiator, is connected to the liquid input control port of this circulating pump 15.
[0013] As for this radiator 16, that surplus liquid and a working-fluid exhaust port are connected to the input side of the above-mentioned circulating pump 15, respectively. And the accumulator 17 for pressure regulation is connected to the pars intermedia of a circulating pump 15 and a radiator 16.
[0014] Steamy path 10a for the steamy discharge is connected to the steamy input edge of the differential pressure regulator 18, and, as for the 1st evaporator 10 of the above, liquid path 10b for the surplus liquid discharge is connected to the liquid input edge of the differential pressure regulator 18. The steamy outgoing end is connected to the steamy input edge of a radiator 16 through a pressure regulating valve 19, and, as for the differential pressure regulator 18, the liquid outgoing end is connected to the surplus liquid input edge of a radiator 16.
[0015] Moreover, steamy path 11a for the steamy discharge is connected to the steamy input edge of a radiator 16, and, as for the 2nd evaporator 11, liquid path 11b for the surplus liquid discharge is connected to the liquid input edge of a radiator 16.
[0016] As shown in drawing 2 , specified quantity hold of the working fluid is carried out into container 18a, the above-mentioned differential pressure regulator 18 is divided into steamy tub 18c and 18d of cisterns through diaphragm-valve 18b, and steamy path 10a of the 1st evaporator 10 is connected to the steamy tub 18c. And liquid path 10b of the 1st evaporator 10 is connected to the feed hopper of 18d of cisterns of container 18a.
[0017] Moreover, the above-mentioned pressure regulating valve 19 is connected to the steamy exhaust port of container 18a, and the liquid exhaust port is connected to the surplus liquid input edge of the above-mentioned radiator 16. Thereby, the pressure of the steamy tub 18c is set up, die YAFUMU valve 18b moves up and down following this, and container 18a controls the pressure of liquid path 10b of the 1st evaporator 10 by adjustment actuation of a pressure regulating valve 19. Then, it is in the condition in which the differential pressure of the steamy path 10a and liquid path 10b was maintained at the desired value, and the 1st evaporator 10 had the vapor-liquid-separation function, and adjustable [of the amount of supply of a working fluid] is carried out, and adjustable [of the temperature control range] is carried out.
[0018] By the above-mentioned configuration, drive control is first carried out by the control section which an accumulator 17 does not illustrate, it sets up corresponding to the heating element with which the pressure of a two-phases flow object loop formation is thermally combined with the 2nd evaporator 11 and which is not illustrated, and the temperature control range of a system is set up.
[0019] A pressure regulating valve 19 is operated by coincidence according to the temperature control range required of the 1st evaporator 10. Thereby, as mentioned above, motion control of the differential pressure regulator 18 is carried out, it is in the condition maintained so that the differential pressure of steamy path 10a of this 1st evaporator 10 and liquid path 10b might have a desired vapor-liquid-separation function, adjustable [of the amount of supply of a working fluid] is carried out, and an adjustable setup of the 1st evaporator 10 is carried out in the temperature control range required of a heating element (not shown).
[0020] Next, drive control of the circulating pump 15 is carried out, and circulation supply of the

working fluid is carried out in the liquid route 12 of a two-phases flow object loop formation. Then, circulation supply of the working fluid of the specified quantity is carried out through flow control valves 13 and 14 at the 1st and 2nd evaporators 10 and 11. Here, in the temperature control range according to the setting pressure of the two-phases flow object loop formation, the 2nd evaporator 11 evaporates the supplied working fluid, takes the heating value of the above-mentioned heating element (not shown), and supplies the steam to a radiator 16 through steamy path 11a. Under the present circumstances, the surplus liquid of the 2nd evaporator 11 is led to a radiator 16 through liquid path 11b.

[0021] Moreover, the 1st evaporator 10 is in the condition that the differential pressure of the steamy path 10a and liquid path 10b was kept constant through the pressure regulating valve and the differential pressure regulator. By carrying out an adjustable setup of the amount of supply of a working fluid with the 2nd evaporator 11 Adjustable is carried out to the temperature control range according to the setting pressure of a two-phases flow object loop formation, the heating value of the above-mentioned heating element (not shown) is taken in the temperature control range according to the supplied working fluid, and the steam is supplied to a radiator 16 through steamy path 10a. Under the present circumstances, the surplus liquid of the 1st evaporator 10 is led to a radiator 16 through liquid path 10b.

[0022] A radiator 16 condenses the steam inputted from the 1st and 2nd evaporators 10 and 11, and radiates heat in a heating value, the working fluid and surplus liquid from the 1st and 2nd evaporators 10 and 11 which were condensed are again supplied to the 1st and 2nd evaporators 10 and 11 through a circulating pump 15, and the thermal control of each heating element (not shown) is performed.

[0023] Thus, the above-mentioned two-phases flow object loop-formation type thermal control system Where it has arranged the 1st and 2nd evaporators 10 and 11 of a vapor-liquid-separation mold to juxtaposition in the liquid route 12 of a two-phases flow object loop formation and the 1st evaporator 10 is maintained at the value of a request of the differential pressure of the steamy path 10a and liquid path 10b among those Adjustable control only of the amount of supply of a working fluid was carried out, and it constituted so that it might be set as the control range in which the temperature control range differs from the 2nd evaporator 11.

[0024] After securing the vapor-liquid-separation function of the 1st evaporator 10 according to this, since it becomes possible to perform to coincidence the thermal control of the heating element (not shown) with which calorific value differs by the ability setting up so that it may differ from the temperature control range of the 2nd evaporator 11 by the same two-phases flow object loop formation, as compared with the former, it can plan in mitigation-ization of a component part, and simplification of a thermal control system design is realized.

[0025] In addition, although explained by the case where carried out the parallel arrangement of the 1st and 2nd evaporators 10 and 11, and a system is constituted from a gestalt of the above-mentioned implementation, it is also possible to carry out the parallel arrangement of the three or more evaporators, for example, and to constitute possible [a setup] so that each temperature control range may be differed, without restricting to this. According to this, the effectiveness that simplification of a thermal control system design can be attained further is done so.

[0026] Moreover, although explained by the case where the differential pressure regulator 18 for temperature control is constituted from a gestalt of the above-mentioned implementation using the mechanical thing using diaphram 18b, it is also possible to change the differential pressure of an evaporator electrically, for example, and to constitute using the so-called valve adjusting method by motor drive, without restricting to this. therefore, this invention comes out not to mention the ability to carry out various deformation in the range which does not deviate from the summary of this invention, without restricting to the gestalt of the above-mentioned implementation.

[0027]

[Effect of the Invention] As explained in full detail above, as diversification of the thermal control

range can be attained, according to this invention, the two-phases flow object loop-formation type thermal control system which enabled it to attain facilitation of the handling including a design can be offered with a simple configuration.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

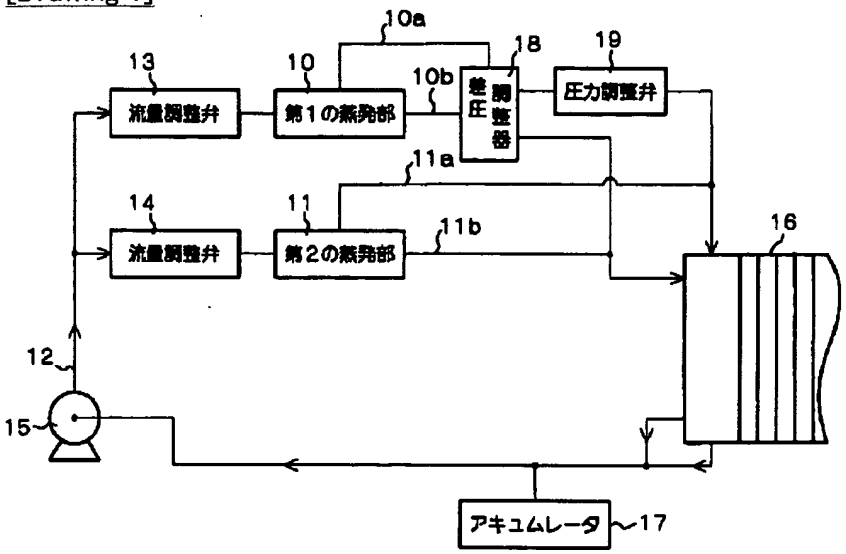
[Brief Description of the Drawings]
[Drawing 1] Drawing having shown the two-phases flow object loop-formation type thermal control system concerning the gestalt of 1 implementation of this invention.
[Drawing 2] Drawing having shown the detail of the differential pressure regulator of drawing 1 .
[Description of Notations]
10 11 -- The 1st and 2nd evaporators. 10a, 11a -- Steamy path. 10b, 11b -- Liquid path. 12 -- Liquid route. 13 14 -- Flow control valve. 15 -- Circulating pump. 16 -- Radiator. 17 -- Accumulator. 18 -- Differential pressure regulator. 18a -- Container. 18b -- Diaphragm. 18c -- Steamy tub. 18d -- Cistern. 19 -- Pressure regulating valve.

[Translation done.]

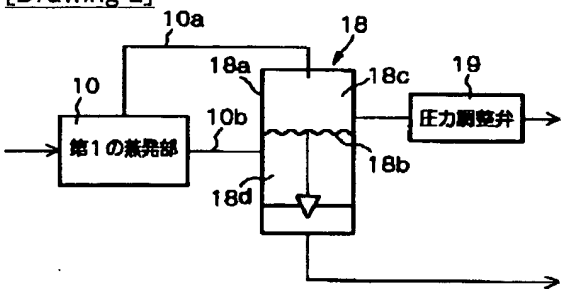
* NOTICES *

DRAWINGS

[Drawing 1]



[Drawing 2]



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